CHEMISTRY

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FUSION POWER — How Soon?

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Editorial:
Fusion for Future Power?
Inside Front Cover

50¢

Thirty-second Year

A SCIENCE SERVICE PUBLICATION

Fusion For Future Power

➤ ONE OF THE greatest achievements of science and technology was the development of the fission atomic bomb during World War II followed by the fusion or so-called hydrogen bomb.

From the frightening weapon of the H-bomb great fusion power for peaceful purposes may come. The vast seas of the earth would be "mined" for supplies of the double weight hydrogen, deuterium, that promises to become the inexhaustible fuel for the earth's future energy.

Successful fusion power might compensate for the great fear and real danger of atomic death for most of humanity.

Fusion power is for the future. The fusion equivalent of the first self-sustaining chain fission reaction is probably still years away.

The half-dozen actually operating fusion experiments exhibited by the U. S. Atomic Energy Commission at the Second Atoms for Peace Conference at Geneva was an impressive demonstration of the magnitude of this research effort. The whole world should have been convinced that we are attempting to give it fusion power by taming the might of the H-bomb.

The unwrapping of secrecy surrounding fusion is so recent that textbooks can not be expected to keep up with the possibilities and progress. The research story is far from finished, but CHEMISTRY, as in this issue, will tell the facts as they unfold.

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▸ SYMBOLIC *of the extensive research on fusion or H-bomb harnessed power is this model at the entrance of the U. S. Atomic Energy Commission fusion power exhibit at the Geneva Atoms for Peace conference. Dr. Arthur E. Ruark, chief of the A.E.C. thermonuclear branch, views model in this Science Service staff photo.*

FUSION POWER

— *How Soon?*

A first-hand report from the Geneva atomic meeting

First Step in H-Bomb Power?

A Report from Geneva

▶ THE FIRST STEP toward peaceful harnessing of energy of the H-bomb, the thermonuclear or fusion reaction, may have taken place before the very eyes of the visitors to the United States fusion research exhibit that dominates the Second United Nations International Conference on the Peaceful Uses of Atomic Energy in Geneva.

Transported from the United States were major parts of the four large laboratories that for half a dozen years have been working on machines to make heavier chemical elements out of light ones with a release of energy, not explosively as in the H-bomb but gradually and under control.

The big question is: Has there been achieved the production of thermonuclear neutrons? No one really knows, but there is a possibility that one of the giant fusion experimental machines, transported across the Atlantic at such great cost of time and money, is actually giving off these neutral nuclear particles, which in a decade or more can be turned into practical generation of energy.

The machine that may be pioneering in thermonuclear neutrons is called Scylla and it was made at the Los Alamos Scientific Laboratory, N. Mex., operated by the University of California for the U. S. Atomic Energy Commission.

The scientists who operate Scylla under the direction of Dr. J. L. Tuck are very careful not to claim that thermonuclear neutrons have been produced because fake neutrons have fooled scientists before and led to false hopes on the part of American, British and Soviet experimenters.

The task of harnessing the H-bomb reaction involves taking molecules of heavy hydrogen (deuterium), which is the fuel, turning them into what is called a plasma, compressing the plasma very rapidly by means of a rapidly rising magnetic field for exerting the necessary pressure on the plasma. This produces great heat necessary for the combination of the deuterium into heavier elements, with conversion of some of the mass or weight into energy. Repeated compressions in a tube of deuterium gas surrounded by a rapidly changing magnetic field bring bursts of neutrons that may be evidence of extremely high temperatures in the plasma, which with confinement is known to be a necessity for fusion. This happened as the visitors to the U. S. exhibit watched and it may be a historic episode in atomic science happening in full view of anyone who went to see.

Scylla is only one of more than a dozen U .S. fusion exhibits, most of which are operating and actually being used for experimental work by

▲ THERMONUCLEAR *experimental machine, DCX, showing glowing ring of atomic ions held by the magnetic field.*

the more than a hundred specialists who are this summer making Geneva the fusion capital of the world.

There is a dramatic device of the Oak Ridge (Tenn.) National Laboratory called DCX (Direct Current Experiment). With a bright light, a beam of high energy particles is injected into a highly evacuated tank inside which is a strong magnetic field to confine the particles.

There are various pinch devices, so-called because they restrict the plasma. They have such intriguing names as Perhapsatron and Columbus. There is also the Stellarator of the Princeton University fusion laboratory, which looks like the skeleton of a prehistoric monster in outside appearance. And there are the magnetic mirror machine and the Astron from the University of California Radiation Laboratory fusion research effort.

Both Britain and the U. S. S. R. showed in their exhibits some of the details of their efforts toward fusion power. But fusion exhibits other than those of the United States were not actually operating. The principal Soviet fusion exhibit was merely a tenth-scale static model.

To create the Geneva fusion exhibit approximately a quarter of the U. S. fusion research effort was transferred to Geneva. Whether there will be an enrichment of ideas from discussions with scientists working on fusion in Russia, France, Western Germany and Japan that will speed our efforts remains to be seen. There has been exchange of information with Britain for several years.

There is talk of joint research efforts with other nations, especially Russia, now that the U. S. progress has been released from secrecy and displayed publicly. Whether this will ever happen is for the future. It involves political policy, which scientists do not decide.

W. D.

(For an extensive account of the background and details of thermonuclear research, consult CHEMISTRY *for February, 1958.*

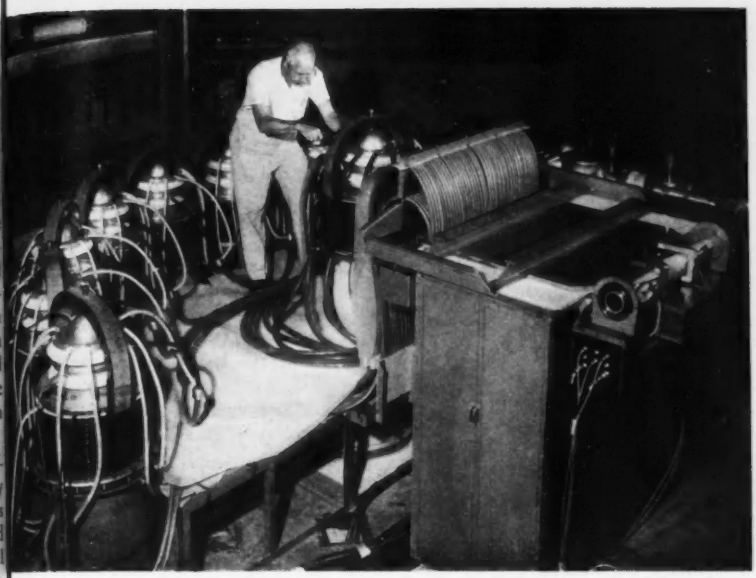
Peaceful H-Bombs Before Fusion Control?

➤ GIGANTIC underground hydrogen-bomb explosions will produce electricity before the fusion process can be harnessed, Dr. Edward Teller of the University of California's Radiation Laboratory predicted.

Addressing the Second United Nations International Conference on Peaceful Uses of Atomic Energy, Dr. Teller said that controlled hydrogen fusion is economically improbable before the year 2000.

But, he said, it is probable that at a much earlier time the tremendous energy of H-bombs exploded deep in the earth could convert rock water into high-pressure steam useful for the generation of electricity. The bomb could also be used to move earth for the building of harbors and canals, to change the distribution of water of rivers and lakes, and to bare minerals for mining.

Hydrogen fusion processes operate



▸ SCYLLA *fusion device. The semicircular bank of capacitors is charged to 80 kilovolts and then discharged around the tube shown at the right of the photograph.*

with low radioactive contamination levels and at low cost due to the cheapness of deuterium, a fuel of fusion.

In this writer's opinion, power derived from both explosions and controlled fusion are probable within the next several years. One way by which fusion power could be obtained is the direct production of electricity from a hot plasma of heavy hydrogen (deuterium) interacting with magnetic fields which would eliminate heat exchangers and many moving parts of the generating apparatus and make the future of thermonuclear reactors attractive.

When achieved, controlled thermonuclear power will dominate human planning for the far future. Man's present sources of power, predominantly oil and coal, are in limited supply. They will have to be replaced sooner or later by other sources, preferably cheap and plentiful. Hydrogen fusion and power from the sun — which ultimately comes from fusion processes in its interior — are among the most promising.

The eight metals which are considered most precious are platinum, palladium, rhodium, ruthenium, iridium, osmium, gold and silver.

Heavy Water Slows Life Processes

➤ THE LIFE PROCESSES of mice and rats can be slowed when they are given relatively large amounts of heavy water, which contains deuterium, instead of regular water.

The animals usually die when the heavy water rises to about a third of the natural body water but no permanent adverse effects were found when the level was maintained at 25% heavy water.

In a report at the Second International Conference on Peaceful Uses of Atomic Energy in Geneva, ten United States scientists reported their studies of the effects of deuterium on growth processes. They were also looking for chemical compounds that could be used in disease treatment.

Heavy water, found in small proportions in all natural water, is the form of hydrogen containing double-weight deuterium. Its main use is as a moderator to slow down neutrons in atomic reactors but it also has value in probing fundamental biological problems.

Deuterium seems to retard most greatly the growth of the most active living cells, of which cancer is an abnormal example.

The scientists therefore implanted cancerous tumors in mice, then let them drink heavy water. They found tumor growth was slower in these mice than in those drinking ordinary water.

Another possible application of deuterium, the scientists suggested, would be in slowing down metabolism of the living system so that a medicine administered in reasonable quantities would have more time to act before it is eliminated from the body.

The scientists conducting this research are Dr. Joseph J. Katz, Dr. Henry L. Crespi, Dr. Asher J. Finkel, Dr. John F. Thomson, William Chorney and Dr. Nobert J. Scully of the Argonne National Laboratory, Lemont, Ill.; Dr. Robert J. Hasterlik of the Argonne Cancer Research Hospital, Chicago; Dr. William Lester, Jr., and Dr. Sung Huang Sun of the Suburban Cook County Tuberculosis Hospital - Sanitarium, Hinsdale, Ill.; and Dr. Robert L. Shaffer of the University of Chicago.

Fission Recoil For Chemical Use

➤ THE POSSIBILITY of using the energy of fission recoil fragments — through the conversion of nuclear energy to heat and also directly to chemical energy — for industrial chemical processes is reported by a group from the British Atomic Energy Authority at Harwell. Most promising, they said, are the synthesis of ammonia to hydrazine, production of nitric acid and the synthesis of hydrogen.

After World War II, plastic pipe came into prominence in water systems and in high hazard specialized chemical services where metal pipe had been unable to withstand the tremendous corrosion encountered in such applications.

ACS MEETING

Highlights from the 134th National Meeting of the American Chemical Society at Chicago in September

Fourth Military Service Urged

▸ CREATION of a fourth military service, equal in stature to the Army, Navy and Air Force, which would conduct all research and development activities of the Department of Defense, was proposed by Dr. Clifford F. Rassweiler in his presidential address.

Only by centralizing research and development in a separate unit, the ACS president said, can the armed services develop the management team of experts they need to provide the "vigorous, fast-moving, well coordinated, and effective program in the military equipment and weapons development field" which our national security demands.

Dr. Rassweiler is vice-president for research and development of the Johns-Manville Corp., New York.

Military research and development work is one of four areas in which, Dr. Rassweiler said, the United States is "failing to achieve essential effectiveness" because it is not providing the incentives necessary to encourage maximum effort. The other areas he cited are: staffing our schools with an adequate number of well trained teachers, persuading American youth in general to seek a really sound education, and interesting young people of outstanding ability in careers in science and engineering.

Divided Responsibility

At present, responsibility for the development of military equipment and weapons is divided among the Army, Navy and Air Force. Yet, he said, no officer in these existing services is given any incentive to devote his lifetime to becoming an expert in the field of either doing or directing research and development work.

"The responsibility officers assume for research and development is an interlude in lifetime careers where advancement depends primarily on performance in command positions concerned with training and maintaining troops with the best possible combat effectiveness," Dr. Rassweiler asserted. "Advancement to top grades is closed to officers who have spent too much time in scientific or development activities, and the system, therefore, forces such officers into early retirement.

"Inventing and developing new things is a highly specialized activity.

It cannot be supervised or carried on effectively by men for whom such activity is a part-time, minor responsibility or a responsibility which is assumed for short intervals as part of a generalized training in which the major emphasis is on other types of activity."

Not by Money Alone

Many of the measures proposed in recent years to solve the nation's critical problems have relied primarily on "the power of money and the anticipated achievements of government appropriations," Dr. Rassweiler recalled.

"Yet . . . it is people, not appropriations, that solve problems. Men with little money but with vision, initiative, and the will to do have accomplished wonders. Without such people, large sums of money become a source of waste, corruption, and failure."

Students Need Incentives

In the field of education, Dr. Rassweiler pointed out, the first major program to be advanced for its improvement was a multi-billion-dollar appropriation request for the construction of more school buildings. It is much more important, he asserted, to provide enough good, well-trained teachers — and to do this it is necessary to provide adequate monetary rewards and other incentives.

Students also need better incentives if they are to be persuaded to choose intellectually stimulating, and usually more difficult, subjects, such as science and mathematics, instead of courses demanding less time and effort.

One possible solution to this problem, the speaker suggested, would be to divide the high school curriculum into three groups: courses for developing intellectual ability, less difficult but interesting courses, and those concerned with craft training.

Scholastic honors and scholarships might be given only for achievement in those courses requiring intellectual effort, and colleges might consider only grades in such subjects when determining an applicant's rank.

To achieve a satisfactory rate of scientific and technological progress, Dr. Rassweiler continued, there must be incentives to persuade men and women of exceptional ability to obtain the advanced specialized training necessary to carry out scientific and engineering tasks.

Vulcanization by Irradiation

➤ Atomic radiation may soon replace heat and chemicals in vulcanizing some rubber compounds.

Irradiation vulcanization will not ordinarily be as cheap as conventional vulcanization. In fact, the actual radiation vulcanization step in rubber processing will probably be more expensive for the next 10 years.

Dale J. Harmon, B. F. Goodrich Research Center, Brecksville, Ohio, told the chemists that irradiation will eliminate many compounding ingredients, and appreciable saving may be

introduced by the elimination of such items as curing pits, molds and curing ovens.

Vulcanization, whether with heat and chemical accelerators or with atomic radiation, is the process of curing sticky raw rubber to form tough, bouncy, useful products.

Until someone discovers a method of reducing the radiation dose necessary for vulcanization, and thus reduce its cost, irradiation vulcanization's chief advantages will be:

1. Curing rubber goods that are difficult or impossible to cure by chemical means.

2. Curing thick goods uniformly all the way through.

3. Curing extruded goods, such as tubing, without heat.

Convert Oil Shale to Gas

▸ COLORADO OIL SHALE can be converted directly to heating and fuel gas by a highly efficient new process.

The process produces gas about as efficiently and economically as natural gas, and more so than most manufactured gases, Eugene B. Schultz, Jr., Institute of Gas Technology, Chicago, reported.

An important advantage to the process, besides by-passing the liquid oil stage, is that it converts between 90% and 100% of the active matter in oil shale to fuel. Existing oil extraction processes utilize only about 80% of the active organic matter in the shale.

The figures are only preliminary calculations based on laboratory experiments performed in cooperation with Dr. Henry R. Linden, research director.

Hydrogasification, as the process is called, was described as a one-step process during which crushed oil shale is treated with hydrogen at high temperature and pressure.

Test Predicts Behavior of Oil

▸ A SIMPLE, rapid test that accurately predicts what will happen to various types of fuel oils when stored over long periods has been developed.

The test allows chemists to learn in 15 minutes what otherwise might take up to 18 months of storage to find out, Drs. A. C. Nixon and B. M. Steckler, Shell Development Company, Emeryville, Calif., reported.

They measure the "filterability" of a fuel oil through a hypodermic syringe and draw upon this figure for information about the oil's sludge-forming characteristics.

This not only tells chemists how badly stored oil might clog furnace burners, but also gives them a quick test of various additives' performances in prolonging optimum fuel life.

ACS Meeting

Chemical Detection of Germ Warfare

➤ A CHEMICAL MEANS can detect deadly germ warfare agents. The same technique can also be used to detect pollen in the air, Dr. Carl O. Thomas, Bell Telephone Laboratories, Murray Hill, N. J., said.

The germ warfare agents would reveal themselves to Army chemists only indirectly as hydrogen cyanide. Germs, which are composed of protein, form hydrogen cyanide when heated in glass tubes at 600 degrees to 900 degrees Fahrenheit. The cyanide gas would be detected by normal chemical means. Since pollen is protein, it also can be detected by the method.

The method was developed several years ago under an Army contract at Southern Research Institute, Birmingham, Ala., and was only recently declassified. It is not necessarily the technique that actually would be used for protection against germ warfare.

Since many other protein substances are normally present in the air, technicians using the new technique will have to maintain a background count, and then watch for sudden increases in atmospheric protein count which could be attributable to germ warfare agents.

Freons Lubricate at High Temperatures

➤ THE CHEMICAL that cools the housewife's refrigerator may help solve a major high-temperature lubricating problem in missile and aircraft development.

Several gases of the Freon family, a widely-used refrigerant, have been found to lubricate some metal alloys at temperatures up to 1,200 degrees Fahrenheit, Donald H. Buckley of the Lewis Flight Propulsion Laboratory, Cleveland, Ohio, reported.

The gases combine chemically with the metal to be lubricated and form a film that reduces friction. Not all Freon gases will react in such a way with all metals.

He pointed out that one of the gases was an effective lubricant for certain steels at lower temperatures, but above 600 degrees the metal was corroded. In view of the corrosive action, research was turned to the use of nickel and cobalt alloys. It was found that gases containing bromine atoms were effective with nickel alloys and gases containing chlorine had superior lubrication properties with cobalt alloys.

Mr. Buckley, a lubrication research engineer, explained the gaseous lubrication reaction as follows:

When metals slide together in aircraft and missile operations, they build up frictional heats as high as 1,100 degrees at the points of contact above the surrounding temperatures. The gases decompose at these local hot spots and form compounds with the metal alloys capable of effective lubrication.

Synthetic Gum for Laundry

➤ "TATTLE-TALE GRAY," already greatly reduced as an obstacle to sparkling white clothes, may be eliminated completely by chemists who have been studying the hows and whys of a synthetic gum used recently as a laundering aid.

Chemists generally agree that a synthetic gum, carboxymethyl cellulose (CMC), when added to detergents greatly reduces tattle-tale gray.

Tattle-tale gray is caused by laundry water dirt that is redeposited on clothes.

Although the gum additive helps housewives and laundries, chemists have not known why or how it operates.

James W. Hensley, manager of Wyandotte Chemicals Corporation's Nucleonics Laboratory, Wyandotte, Mich., told the meeting such information could be used to improve laundry aids, and also to end a major squabble among chemists who hold different theories on the matter.

A popular theory has been that CMC coats clothing fibers during laundering and prevents soil particles from clinging to them. Attempts to test the theory have been inconclusive because the amounts of gum adsorbed, if adsorbed at all, are too small for careful measurement.

Mr. Hensley "tagged" some CMC with radioactive carbon atoms incorporated into its make-up. Routine laboratory counters enabled him and coresearcher Clyde G. Inks to make the otherwise almost impossible measurements.

They found that, although the gum was not ordinarily adsorbed on cotton fibers, it coated the fibers if detergents were present. In the case of wool and some synthetics, the gum adsorbed was less than in the case of cotton.

Careful measurements showed a definite correlation between adsorption of CMC additive and reduction of tattle-tale gray, Mr. Hensley reported.

Advance Arthritis Knowledge

➤ A NUMBER of substances have been found in the blood which may offer a clue to the mysteries of rheumatoid arthritis.

Blood samples taken from some of the 4,000,000 Americans afflicted with the disease have revealed that rheumatoid factor is composed of several closely related proteins, Dr. Ralph Heimer, a biochemist at the Hospital for Special Surgery, New York, reported. Study of these rheumatoid factor proteins might offer a clue to the unknown cause of the disease.

At least three different proteins were found, all in extremely small amounts. As little as one seventy-thousandth of the total circulating serum protein in arthritic blood was found to be made up of these special proteins.

The newly identified protoins resemble some of the unusual proteins associated with other diseases, such

as hepatitis, syphilis and certain kinds of anemias. They also seem related structurally to the common antibodies found in the blood.

It seems, Dr. Heimer pointed out, that the rheumatoid factor proteins may be auto-immune bodies. These are substances manufactured by the individual in defense against his own body materials which have been altered through disease.

"The response by the body to its own products, while also perhaps a protective device, proves under many circumstances to be disadvantageous," the scientist said. Auto-immune bodies apparently play a role in some disease related to rheumatoid arthritis.

New sensitive isolation techniques — one protein was detected although only one three-billionth of an ounce was present — are expected to aid greatly studies of rheumatoid arthritis.

Olga M. Federico and Dr. Richard H. Freyberg, also of the Hospital for Special Surgery, were co-authors with Dr. Heimer of the report.

Chemicals Against Fatigue

➤ CHEMICALS related to the rocket fuel, hydrazine, have shown powerful stimulating action against depression and fatigue in laboratory animals.

Extensive clinical trials of the most promising member of the group, 1-phenyl-2-propyl hydrazine, for treatment of the depressed state in human beings are underway. The chemical's code name is JB-516. Dr. John H. Biel, chief of the chemistry division of Lakeside Laboratories, Milwaukee, made the report. Dr. Alexander Drukker, senior research chemist, was co-author.

The new agents act by directly stimulating the central nervous system and by blocking the brain enzyme that destroys adrenalin and other activating hormones. Enzymes are naturally occuring chemicals that control the speed of body processes.

JB-516 has been shown in laboratory tests to inhibit the brain enzyme for an entire week.

One shortcoming of drugs now used to treat depression in humans is that the chemicals are rapidly destroyed by the body's enzyme system. They also tend to lose their effects on repeated administration, to have undesirable depressing after-effects, to decrease appetite, and to increase blood pressure and pulse rate, Dr. Biel said.

The new hydrazine-related chemicals produce a prolonged effect with no following period of depression, tend to lower blood pressure and increase appetite rather than decrease it.

By bombarding mixtures of chemical compounds such as human blood with neutrons, some nuclei will absorb neutrons and become radioactive, making possible a rapid and sensitive analysis by gamma ray spectrograph.

For the Home Lab

Cadmium

by Burton L. Hawk

Cadmium is one of the more quiet, unassuming elements. It is not very plentiful, nor does it have any spectacular properties to show off. Nevertheless, we should not ignore it. It has its place and it has its uses.

Discovery

Cadmium was discovered by a German professor, Dr. Friedrich Stromeyer, in 1817. The careful investigations of Stromeyer leading to the discovery parallel the efforts of a modern Perry Mason to solve a murder. In his capacity of inspector-general, Stromeyer inspected the preparations stocked by the apothecaries of Hanover. He was surprised to find a certain preparation contained zinc carbonate instead of the zinc oxide it was supposed to contain. Further, he noticed that when this zinc carbonate was heated it turned yellow-orange in color.

Puzzled as to why this substitution was made, he visited the firm which manufactured the product. There he was told that the oxide could not be prepared properly (by heating the carbonate) without obtaining a yellow color. Hence the carbonate was supplied without any further attempt to convert it to the oxide. Dr. Stromeyer could not understand this peculiar reaction and started to experiment with the questionable zinc oxide himself.

After eliminating all possible known impurities, he deduced that a new substance must be present. He then dissolved the oxide in sulfuric acid, added hydrogen sulfide, filtered off the precipitate, dissolved it in hydrochloric acid and evaporated it to dryness and then added ammonium carbonate solution.

The zinc carbonate dissolved in excess ammonium carbonate; however a portion of the precipitate would not dissolve. This he separated and heated to obtain a brown powder. Upon reducing the brown powder with carbon, he obtained a bluish gray metal and thus was the first person to view the new element, cadmium.

Chief Source

Strange as it may seem, the chief source of cadmium is zinc ore. Although a few cadmium minerals are known, such as greenockite, CdS, they are very rare. Almost all of the ores of zinc contain cadmium. Since cadmium is more volatile and more easily reduced than zinc it is distilled off first during the reduction of zinc. Thus cadmium is always obtained as a by-product during the refining of zinc.

Home Experiments

Since the metal is readily available, we will start with it for our experimenting. You can obtain it in "mossy" form similar to zinc. It is rather expensive, but only a small quantity will be needed. Notice that in appearance you can hardly distinguish it from zinc. It is softer, more ductile and more malleable than zinc. Also, it has a lower melting point. Place a

small piece on a spoon and apply heat. Note how easily it melts.

Drop a piece of cadmium in dilute hydrochloric acid. Note the reaction is much more moderate than that with zinc. Cadmium dissolves more readily in nitric acid. Dissolve several pieces in dilute nitric acid. Do not breathe the brown fumes. Continue to add the metal as long as it will dissolve; then filter. You now have a solution of cadmium nitrate. You will need it for the following reactions.

Add a solution of sodium hydroxide to cadmium nitrate solution. A white precipitate of cadmium hydroxide forms. Filter off and heat the precipitate. It is converted into the brown oxide, CdO. This oxide can also be obtained by heating the metal. Melt a piece of the metal in an open pan. Soon you will note the surface is covered with a brown scum of oxide.

Add sodium ferrocyanide to cadmium nitrate to obtain the pastel greenish-white precipitate of cadmium ferrocyanide. A soluble ferricyanide will produce a tan precipitate with cadmium nitrate.

Cadmium Sulfide

One of the best known compounds of cadmium is the brilliant yellow cadmium sulfide. It is prepared by adding a solution of sodium sulfide to cadmium nitrate solution. Or, if you do not have sodium sulfide, bubble some hydrogen sulfide through the cadmium nitrate solution. This compound is prepared by adding dilute hydrochloric acid to ferrous sulfide in a test tube. Stopper the tube with a one-hole rubber stopper containing a glass tube which leads beneath the surface of the cadmium nitrate solution. Remember, hydrogen sulfide is quite poisonous. Avoid breathing it. Filter off the yellow precipitate and allow it to dry. Grind the powder with a small quantity of linseed oil and try it as a paint. Cadmium sulfide is also formed by heating the two elements together. Place a small quantity each of cadmium and sulfur in a crucible. Apply heat, gradually increasing, until the elements have fused together. In this case the sulfide is more of an orange shade.

A peculiarity of cadmium is that it will dissolve in ammonium nitrate solution. Prepare a concentrated solution of the latter and drop a small piece of cadmium in. Allow to stand overnight. If the piece of metal is not too large, it will be completely dissolved. Cadmium nitrate and ammonium nitrite are formed. To prove that the cadmium has dissolved, add sodium sulfide (or hydrogen sulfide). The yellow precipitate is formed.

Some Uses of Cadmium

Recently, cadmium has been used in electroplating iron and steel tools and automobile parts to protect them against rust. It is better adapted for this purpose than zinc and can also be used in place of nickel.

Cadmium is also used in the popular low-melting alloy, Wood's metal, which melts at 71 deg., or below the boiling point of water. This alloy is useful in electric fuses, automatic fire alarms, sprinkler systems, etc. To prepare it, melt together 1 part of cadmium, 1 part of tin, 2 parts of lead and 4 parts of bismuth.

Other compounds of cadmium include the selenide which is a brown powder. However, if a mixture of sodium sulfide and sodium seleni

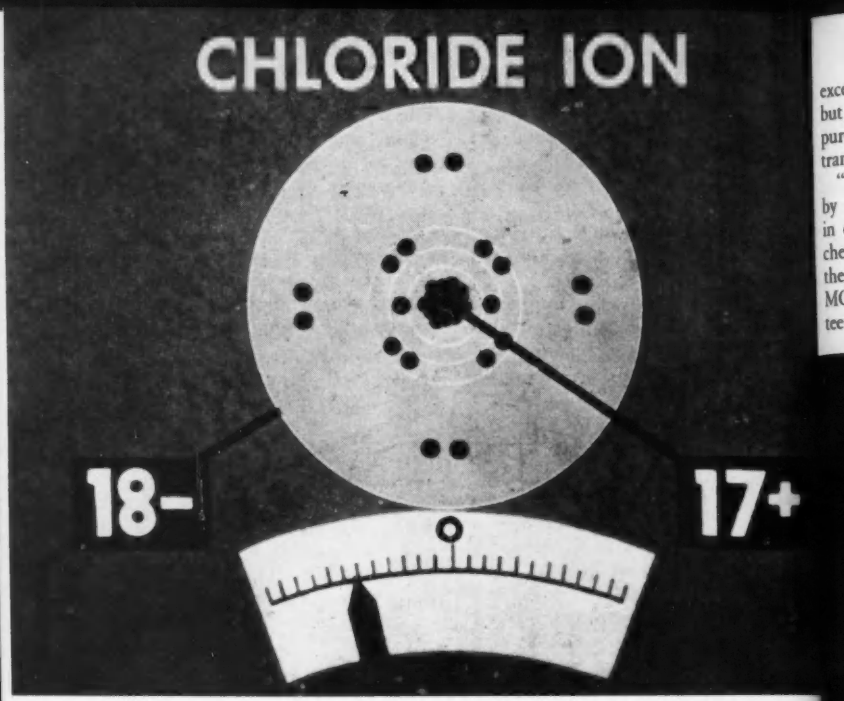
be added to a cadmium solution, a yellow precipitate is formed. When this precipitate is heated to 300 deg. it becomes red and is used as a red pigment in paints under the name of "cadmium red."

When cadmium oxide is fused with potassium hydroxide, potassium cadmate is produced, K_2CdO_2.

The sulfate is used as a catalyst and in the vacuum tube industry. The tungstate is used in X-ray screens. The acetate is used in finishing porcelains and pottery. The bromide is used in photography, engraving, and lithography, as well as the chloride and the iodide. So, this unassuming element has been put to use!

Remember, all cadmium salts are poisonous . . . more so than zinc! Be sure to wash your hands thoroughly after experimenting.

➤ "HE THOUGHT *it was an invasion from outer space — a fly lighted on the telescope lens!*"



➤ AN ANIMATED SCENE *from "Chlorine — A Representative Halogen," shows that the additional electron in its outer shell accounts for the negative charge of the chlorine ion and the fact that the ion is larger than the atom. The film is part of a projected series scheduled by the Manufacturing Chemists' Association as an aid to the teaching of high school chemistry.*

New Films for High Schools

➤ TWO NEW FILMS for high school chemistry teaching, embodying a number of departures from usual teaching film techniques, have been produced by the Manufacturing Chemists' Association Educational Service.

The films, "Combustion" and "Chlorine — A Representative Halogen", are prototypes of a projected series. They were made by Sutherland Educational Films, Inc., of Los Angeles, Calif., and will be offered for nationwide sale to schools by the Sutherland organization during the coming school year. Both are in color.

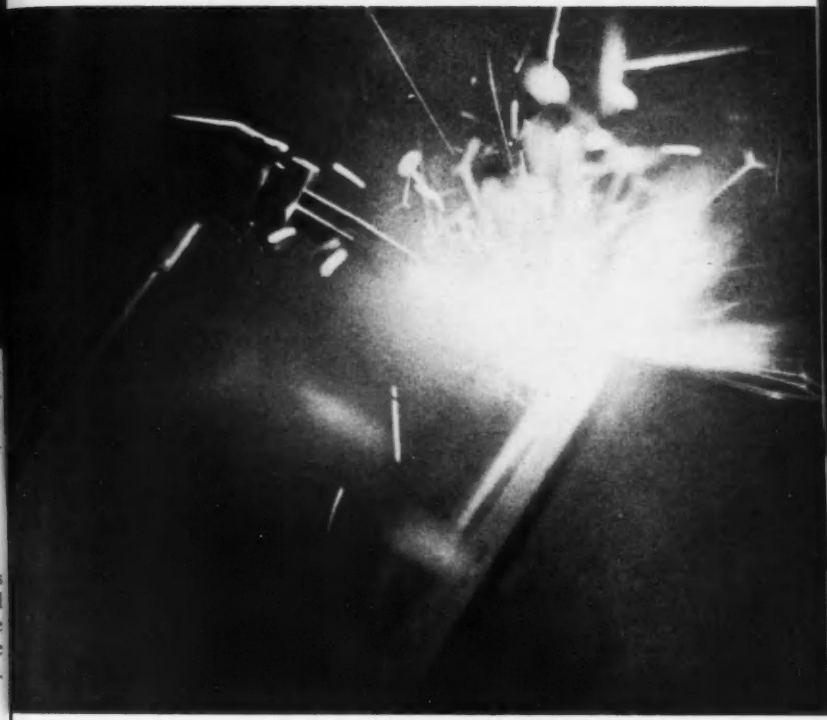
Meet Teacher Needs

The films are designed to fit as closely as possible the requirements of high school chemistry classroom teaching. Surveys indicated that many

excellent films are available to schools, but that they often are made for other purposes and frequently contain extraneous or distracting material.

"We approached this problem first by deciding what we did not want in our films or, more properly, what chemistry teachers did not want in them," said Glen Perry, Chairman of MCA's Education Advisory Committee. "Only after that did we turn to the positive question of what they did want in them. Both from the negative and positive aspects, however, the point is that these films do not represent our unilateral view of what chemistry teachers ought to want, but are tailor-made to their specifications. This is true, for that matter, of all MCA's education material."

"Combustion" runs for 14½ minutes; "Chlorine" for 16½ minutes,



➤ THE INTENSE HEAT *generated by burning acetylene gas with oxygen causes steel to reach its kindling temperature and to burn as a fuel when a supplementary stream of oxygen is supplied. The photograph is from the new film on "Combustion."*

allowing a teacher to use both films effectively in a normal class period.

No Fancy Frills

Each film is as simple and direct as possible. There are no actors. The only human element on the screen is the hands of the demonstrator at the laboratory bench. All live footage is photographed as close to the action as possible to give the student the opportunity to observe the action as though it were on his own bench. There are no background scenes or general laboratory shots except in brief opening and closing sequences showing applications of the subjects.

Animation is used in each film to show ionic movement or similar phenomena. Special care was used to obtain accurate color and to give opportunities to observe chemical changes. Color photography was handled by Winton C. Hoch, A.S.C., Academy Award winner.

The first two subjects were selected on the basis of a survey of chemistry teachers made by Elbert C. Weaver, Peabody Chemistry Master at Phillips Academy, Andover, Mass., who served as educational advisor to the projects. Mr. Weaver prepared content outlines which were presented to a selected panel of science teachers for review. Following panel approval of the outlines, scripts were developed jointly by Mr. Weaver and Sutherland Studio representatives in Los Angeles.

Reviewed by Chemists

Scripts and storyboards were then reviewed by experts in the chemical industry to make sure that the presentations would be accurate and reflect the latest technology in the two subjects. Subsequently storyboards were reviewed by a panel of educators, including science teachers, curriculum specialists, and audio-visual consultants.

"A major contribution of this group," said Mr. Perry, "was their insistence on a higher grade of technology. Both industry people and the film producers felt we should not present information that would be too advanced, but the educators convinced us otherwise."

Reviewed by Educators

Completed work prints were also reviewed by a panel of educators. Arrangements have been made to have the final prints reviewed by leading science education groups and audio-visual departments of cities and universities. The Manufacturing Chemists' Association adopted strict criteria to serve as production guide lines. The following are indicative of these criteria:

(1) The films should be made on subjects which could be effectively exploited by the motion picture medium; not those, for example, which could be taught better through teacher demonstration, filmstrips, or student laboratory exercise.

(2) The films must supplement the teacher and in no sense serve as a replacement.

(3) Wherever possible, the films should present subject matter that normally could not be shown to students for reasons of (a) long duration of action, (b) difficulty with materials and equipment, and (c) possible hazard.

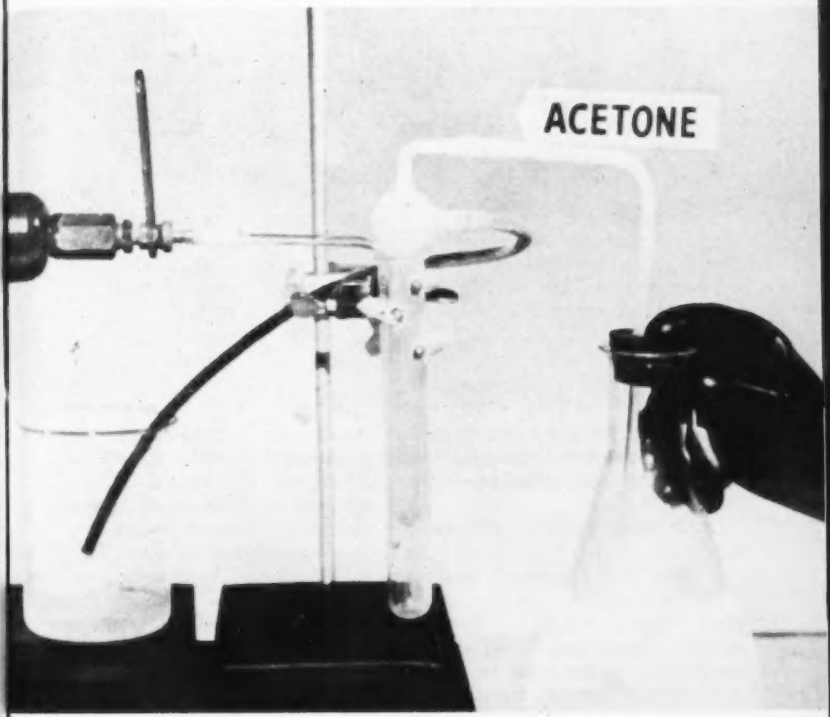
The film "Combustion" convincingly answers the question, "What is fire?" The following points are shown: Conditions for combustion, showing that they can be fulfilled

even if the fuel is under water; rate of combustion and factors that influence the rate; spontaneous ignition; applications of combustion, and the need for continuing study of the subject.

Chlorine

The film on chlorine presents the preparation, physical properties, chemical properties, and uses of chlorine. The following points are shown:

Occurrence of chlorine in compounds; position of chlorine among the halogens; structure of chlorine atoms and ions; laboratory preparation of free chlorine by chemical oxidation of chloride ions; properties of chlorine including solubility and liquefaction; chemical properties, including reactions with metals, non metals, hydrocarbons, bromides, iodides, water, and hydroxides; preparation of chlorine by oxidation of chloride ions by electrolysis; explanation of electrolysis by animation; industrial prep-



➤ THIS SCENE *from the new film, "Chlorine — A Representative Halogen," demonstrates that chlorine gas can be liquefied at minus 34 degrees Centigrade.*

aration of chlorine by electrolysis; uses of chlorine, and opportunities for further research.

Educators who served on the review panels were: Donald Ely, Audio-Visual Department, Syracuse University; Irwin Gawley, State Teachers College, Upper Montclair, N. J.; Saul L. Geffner, Forest Hills High School, Forest Hills, N. Y.; Irmgard Karle, Hunter College High School, New York City; Kenneth Meinke, Board of Education, Hartford, Conn.; Morris Meister, Bronx Community College, New York City; and Carleton Spear, New Rochelle High School, New Rochelle, N. Y.

The film subcommittee of MCA's Education Advisory Committee consists of Ashworth Burslem, Hercules Powder Co., chairman; Dr. Julian Hill and Virgil Simpson of E. I. du Pont de Nemours, Inc., and as ex-officio members, Cleveland Lane of MCA and Mr. Perry, also of du Pont.

Other educational services of MCA include a series of 31 open-ended high school chemistry experiments; teacher and student demonstrations and experiments for general science classes; a program of awards for outstanding chemistry teachers of undergraduates in colleges and universities; and a program of assistance to schools by industry people in communities (See CHEM., Sept., 1958, pp. 25-27).

Need Atomic Reactor Knowledge

➤ THE UNITED STATES is more interested in trying out different types of atomic power reactors for the gain of scientific information than it is in rapidly putting large reactors into operation as part of a kilowatt race with other nations.

Besides, a power reactor authority cautioned, at the present time the choice of reactors "must be made on the basis of incomplete technical data and fragmentary operating experience."

Dr. Norman Hilberry, director of the Atomic Energy Commission's Argonne National Laboratory, Lemont, Ill., pointed out that "there is no economic excuse in the United States for building large numbers of nuclear power plants whose costs for the energy produced are in excess of the cost of plants using fossils fuels."

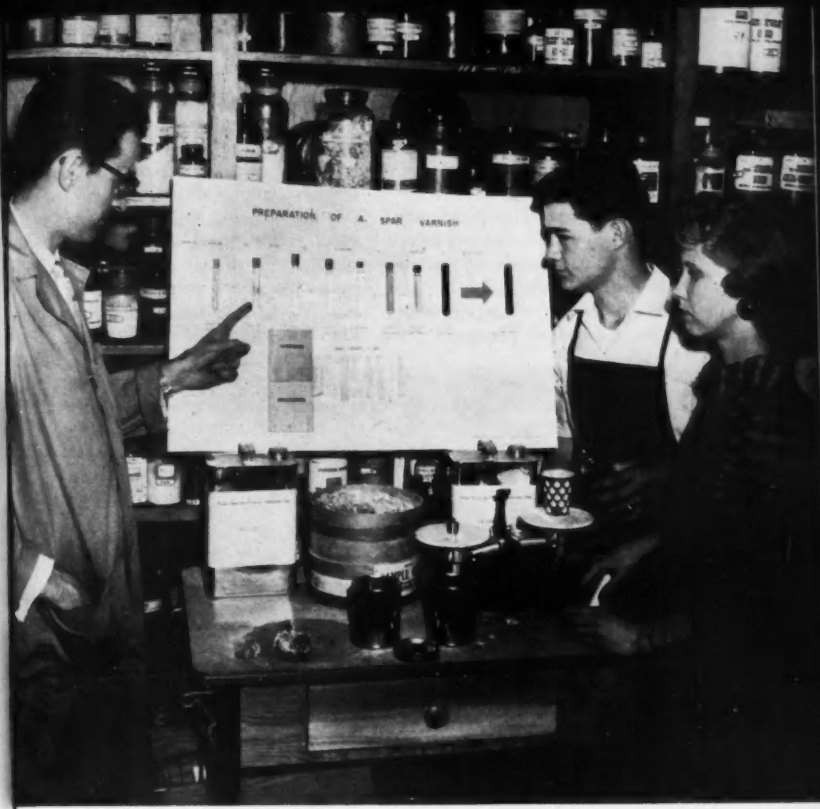
He spoke before a session of the Second United Nations International Conference on Peaceful Uses of Atomic Energy ("Atoms for Peace" conference) at Geneva.

Dr. Hilberry predicted that 15 to 20 years from now America's power producers will have to generate four times today's electrical energy output.

"Long before the reserve of fossils fuels begins to be exhausted, problems of rates of production and transportation will make the use of nuclear fuels essential if the United States is to maintain its rate of expansion of electrical energy."

The actual time by which the U. S. will absolutely have to begin using nuclear fuels is not yet clear, Dr. Hilberry said.

In the meantime, he stressed, we still have a few years in which to conduct research directed toward finding the best types of reactors. We are not yet hard-pressed to put early designs into production, he said.



▸ C. W. Owens, Jr., *with the aid of a graphic chart, explains the preparation of spar varnish to two students enrolled in his paint chemistry course. The students actually manufacture paint and have made their own ball mill for grinding pigments in the do-it-yourself course.*

Texans Make Paint in School Lab

▸ It's easier to paint the town in Dallas, Texas, these days because of a high school paint chemistry course.

Chemical News, Manufacturing Chemists' Assn., Inc., reports chemistry students at Crozier Technical High School are not painting Dallas, but they are manufacturing paint. Each semester, under the guidance of C. W. Owens, Jr., an award-winning chemistry teacher, these students actually prepare paints, varnishes and enamels as a part of their course.

The manufacture takes place dur-

ing the second week after a thorough briefing on the formulation of paints and varnishes. This is probably the most interesting phase of the three-week course as far as the students are concerned. The mixing and the making of a spar varnish, a colored alkyd enamel and a "hammered finish" metal paint takes place right in the school laboratory. Working in pairs, the student teams each prepare a pint of each type.

First week of the course covers the chemical technology of paints and varnishes, including what they consist of, why they dry, their uses and how they are best applied. Oil-base, water-base, latex, and various other types of paints come under discussion.

Having actually made the paint during the second week, the final week covers instruction on the preparation of free paint films — how to apply paint to a glass surface, remove it and cut it into strips for testing purposes. The students also paint and varnish wooden panels to test the paint's drying qualities and its ability to form a smooth finish.

Other course units are devoted to the history of paint, industry opportunities, uses, manufacturing techniques and the science of quality control. Still other units cover the chemical technology of various paints including interior wall paint, spar varnish, architectural and alkyd baking enamel.

Looking back over his special project, Mr. Owens feels that it has been highly successful. "The 'students' not only received a thorough background in the chemistry of paints, but also were 'sparked' with a new interest in the field of science," he points out.

The course was made possible by the Dallas Paint and Varnish Production Club, which furnished all the materials, some of the equipment and assisted in preparing the course. It was the Dallas Club that selected Mr. Owens to attend the first Paint Short Course for High School Chemistry Teachers held at North Dakota State College in 1956.

The novel, yet practical, course earned for Mr. Owens the Science Teacher Achievement Recognition Award — one of the teaching profession's highest honors.

Mulberry Leaves Attract Silkworms

▶ THE "SOMETHING" in mulberry leaves that makes them attractive to young silkworms has been identified. The larvae of silkworms are known to eat fig and lettuce leaves when they are hungry and they are attracted to soy bean and tea leaves. Mulberry leaves, however, seem to be the only ones that both attract and nourish the silkworms. The two attractants in mulberry leaves are beta-gamma-hexenol and alpha-beta-hexenal, both found in the leaf's essential oil, Tadao Watanabe of Kyushu University's agriculture faculty, Fukuoka, Japan, reports in the British scientific journal *Nature*.

One of the causes of "smog" in California is being eliminated through the use of afterburner-type mufflers on trucks and buses.

Uses for Powder Metallurgy Parts

▸ ABUNDANT EVIDENCE of the rapid growth of the powder metallurgy industry will be seen at the Powder Metallurgy Products Exhibit at the Metal Exposition, October 27-31 at the Cleveland Auditorium. An outstanding display of new powder metallurgy components from actual consumer and industrial products will constitute the central focus of the exhibit sponsored by the Metal Powder Industries Federation. The products represented will include appliances, automotive transmissions, power lawn mowers, washing machines, business machines, electric shavers, lighting fixtures, farm machinery, precision tools, release mechanisms for para-

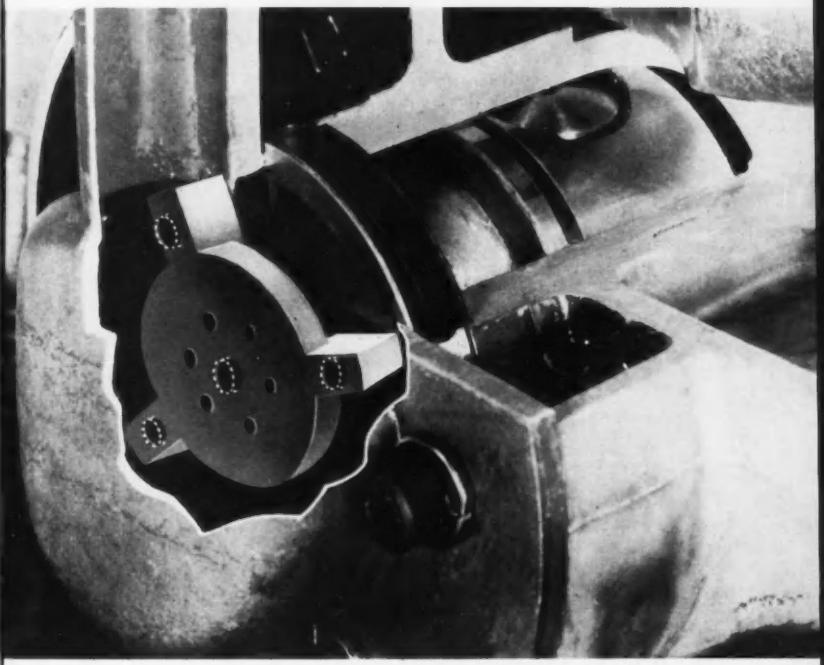


FIG. 1 — *Made of iron powder and infiltrated with a copper alloy, powder metallurgy "spider" serves a vital function in this high-speed hermetic compressor used in General Electric's "packaged" air conditioning units. This part acts as a guide and "backer" for the discharge valve, and supports a portion of the valve plate assembly. Thus, it must meet rigid requirements for high mechanical strength and wear resistance.*

chutes, industrial fasteners, sewing machines and timing devices.

Gears

Powder metallurgy gears of almost every conceivable type and size will be one of the features of the case history display. These include spur, bevel, face, cluster, partial, skip tooth, helical and many other types — furnished with single and multiple openings of various types and shapes, including tapers, counterbores, keys, keyways, splines, squares and eccentrics. It is not generally known that over one million powder metallurgy gears are produced every day in the United States — representing the largest volume of any single structural part made by powder metallurgy.

Cams

Engineers and metallurgists will be equally interested in the display of powder metallurgy cams. Here again, an extremely wide variety of cam types will be shown, including face, radial, box, barrel, internal, multiple plane, and eccentric cams, as well as combination cams and gears. In each case, the part shown represents a current application, and details on the end use of each component will be available from attendants at the booth.

Case Histories

Among the more interesting case histories on display will be a powder metallurgy "spider" (Fig. 1) which is a vital functional part of a high speed hermetic compressor developed by General Electric for its "packaged" air conditioning units.

A dramatic display of portable electric hand tools which contain as many as a dozen powder metallurgy parts

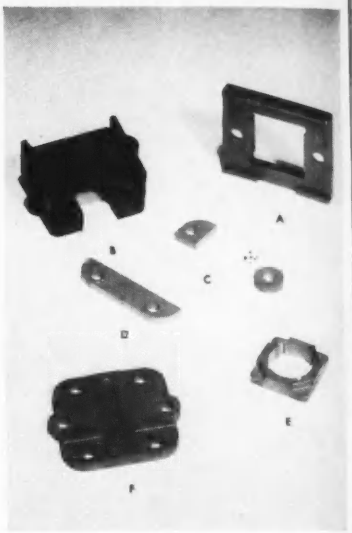


FIG. 2 — *These vital powder metallurgy components are used to achieve a unique orbital blade movement in the Porter Cable Model 548 Bayonet Saw: (A) Drive block made of high density iron; (B) oil-impregnated blade holder saddle made of iron alloy powder; (C, D) upper and lower drive mechanism retainers are oil-impregnated bronze parts; (E) oil-impregnated drive block made of bronze powder; (F) cover used to retain blade holder made from bronze powder and oil-impregnated.*

will occupy another corner of the MPI booth. Notable in this display will be some of the home power tools manufactured by the Porter-Cable Machine Company, Syracuse, New York. Two of these tools — a bayonet saw and an electric hand saw utilize many powder metallurgy parts

(Fig. 2) specifically to obtain orbital motions of the blade, which give these tools a competitive advantage in their specific market.

In the heavy industry field, powder metallurgy components are making unusually rapid strides. A typical example of these advances will be the display of cams, gears, and bearings used in hand and electrically-operated chain hoists. Specific components from chain hoists manufactured by the Chisholm-Moore Division of the Columbus-McKinnon Chain Corporation, Tonawanda, New York, will illustrate the fact that powder metallurgy parts are now well entrenched in the field of heavy structural design.

In addition to industrial components, the display will include other types of applications not generally known as outlets for metal powders. Various producing companies will exhibit powders used in pharmaceutical preparations, friction materials, coatings for welding electrodes, cutting and scarfing powders and rocket fuels. Many newly developed powders and powder alloys will also be shown by the producers.

Participating sponsors in the Powder Metallurgy Products Exhibit include the following:

American Metal Climax, Inc.; Burgess-Norton Manufacturing Co.; The Glidden Co.; Hoeganaes Sponge Iron Corp.; The International Nickel Co.; Johnson Bronze Co.; The New Jersey Zinc Co.; Plastic Metals, Div. National-U. S. Radiator Corp.; The Presmet Corp.; Pyron Corp.; Reese Metal Products Corp.; Republic Steel Corp.; Vanadium-Alloys Steel Co.; Whitaker Metals Corp.; Metal Powders, Ltd.

Parathion May Cause Poisoning

➤ PARATHION, a chemical spray used on apples, pears, grapes, hops and citrus fruits, is being investigated as a possible factor in causing poisoning among crop workers.

A study of a six-year-period of outbreaks among workers, reported in the Journal of the American Medical Association (Feb. 15) by Dr. Griffith E. Quinby of Wenatchee, Wash., and Allen B. Lemmon of Sacramento, Calif., suggests the possibility that the poisoning may be the result of exposure to residues left on plants after they have been sprayed with insecticides.

A striking difference between poisoning produced by direct contact and that of residue contact was that large numbers of workers were affected by residue contact compared to the few cases produced by direct contact with the insecticide.

The residue contact cases are considered milder, and the onset to be more gradual, than the direct contact type, the investigation showed.

The study also demonstrated that of those crops examined, all had foliage at least chest high, which may mean that workers are poisoned only when dusted or bathed in the dilute residues almost from head to foot.

Dimethoate, a new experimental parasiticide, has demonstrated marked efficiency in controlling nasal botflies that attack sheep.

Two Major Nations Have Different Education Goals

Soviet – U.S. Education

by Dr. Dimitri B. Shimkin

Supervisory Statistician, Foreign Manpower Research Office, U. S. Bureau of the Census

➤ In general, my broadest impression is that educational goals in the two countries are basically different. Soviet education is a State training program preparing personnel for planned, predetermined positions in the labor force. American education seeks, in contrast, to develop the inherent capacities of individuals so that they might lead socially useful lives and exercise reasonable judgment as citizens. Soviet training and tests are oriented toward meeting specified performance standards, while American pedagogy attempts also to identify potential abilities and to remedy learning difficulties. Finally, Soviet education maintains student effort through graded material and social incentives commensurate in scale with the State's evaluation of the job to be filled. American education assumes internal motivation on the student's part; furthermore, in this country, educational attainment, economic success, and social status have only moderate intercorrelations.

State Sets Goals

Another basic contrast is in the degree of structuring — of hierarchical order and centralized direction — in the two educational systems. In the Soviet Union, missions, priorities, and means are set by the Communist Party and State. The training of a Party and technological leadership, and of a body of skilled technicians dominate all programs. This concentration has produced unquestionable results. It has also led to an annual retardation and drop-out rate of 20% for primary and secondary education as a whole. That in turn has drastically limited average educational attainments; even in 1955-56, only a third of the industrial workmen (a young and rather select lot) had completed the seventh grade.

In the United States, informal mechanisms and pragmatic adjustments have played vital roles in the total educational scene. For example, the county agent system and the Four-H Clubs have contributed greatly to the technological level of American agriculture. In industry and commerce, the labor unions and business have exercised much influence upon the content and methods of vocational curricula, and even developed extensive programs of apprentice training and intramural education. In many fields, professional societies have built up standards. Finally, the loose fabric of American society has permitted substantial occupational mobility to meet shifting demands for skills. In sum, American education should not be judged in terms of its humane objectives and formal structure alone.

➤ A SYMBOL *of the Soviet push in science education is the University of Moscow science skyscraper that dominates the Russian capital. This scientific manpower factory is a key factor in the Soviet effort to best the United States scientifically and technologically. A statue of the Russian physicist Lebedev sits guard in the foreground.*

An equally vital test is the proven quality of the working labor force.

Some Similarities

The differences between the educational systems of the two nations are counterbalanced by a number of major similarities. Most important is a common vision of an improving society, made possible by universal, publicly financed education. However, neither country has been able to achieve equality of educational access for all its citizens. In the Soviet Union, the rural areas remain severely deprived; in the United States, race and region are the pertinent variables. Furthermore, both nations depend upon elite institutions — the thirty-odd Universities in the U.S.S.R. and leading private schools and colleges in this country — to provide key leaders. However, the Soviets have no counterpart to our large state universities, with their traditions of practical service to their communities, and

with their educational policies of easy entrance but severe attrition. Finally, the great dynamism of both nations has opened avenues of mobility in and out of professional occupations, differences in institutions notwithstanding. As a result, conditions of personal advantage (from the standpoints of security and satisfaction, as well as economic gain) have profoundly modified the formally directed effects of the two educational systems.

Reds Strong and Weak

At various educational levels, the Soviet Union manifests both strengths and weaknesses in comparison with the United States. Thus, while differences in pattern are evident, no simple qualitative judgment appears plausible.

The Soviet grade-school curriculum resembles that of our better progressive schools in its stress on natural history and on observation. Soviet children are conditioned to use their eyes, ears, and hands. They gain a feeling for their environment through nature walks, excursions, and simple experiments. Soviet elementary textbooks are generally good; they are clear, simple, and informative. The weaknesses of Soviet elementary schools derive from the low standards of teacher training, since only secondary education is required to instruct in these grades, and the pay is poor. In addition, classes are large, with double and even triple sessions common.

At the junior and senior high school level, the Soviet school system gives far more formal content, especially in mathematics and physics, than do all but a few American schools. The teaching of chemistry does not seem as good; that of biology, rather poor. The teaching methods used are didactic, with the experimental approach little stressed. There are no Science Fairs. The quality of Soviet secondary training is hard to judge, for the actual, representative test scores achieved in State examinations are not published. Over-all, the average Soviet high school graduate probably knows more facts and handles mathematics better than the average graduate of an American academic high school. Whether many reach the substantive, creative, and motivational levels of our best schools is another question.

In higher education, both countries exhibit vast internal differences. The Soviet Universities give training in the physical sciences equal to the finest in the world; conversely, the narrower institutes, with their minute faculties and shop-practice orientation, are often poor indeed. In biology, Soviet standards are generally low; ours are, in many of the earth sciences. An over-all assessment is difficult to make.

Red Graduate Work Weak

The Soviets have some serious weaknesses in their graduate training. Much time is wasted preparing for examination on Marxism, and the quality of foreign-language skills is low (as in the U.S.!), popular mythology to the contrary notwithstanding. They have, at the same time, two basic assets in advanced training: (a) The intimate integration of their graduate training with the nation's leading research institutes, as contrasted to the isolation of graduate schools from industrial and governmental research in the U. S., (b) The close individual-guidance system by

which each faculty member has a very few persons whom he carefully develops. This gives an intensity of training rarely achieved in this country. It appears to be adequately supplemented, moreover, by graduate-student participation in staff conferences. There is little emphasis upon course work, since most of that is completed at the undergraduate level. On the American side, the comprehensive general examinations prior to candidacy for the Ph.D. are perhaps the major feature of advantage vis-a-vis the U.S.S.R.

In sum, Soviet education, while inapplicable as a general model, offers numerous features which can be studied and even adopted with profit in this country. The systems of other nations, particularly in Western Europe, also present much that is challenging. But a consciousness of a strong American educational tradition is equally important.

Dewey Behind Sputnik

Above all, I would urge that evaluations of American education be kept clear of narrow considerations of military technology or a race in numbers with the Soviet Union. The Sputnik and allied developments represent the payoff of a long-continuing effort by men who were trained, not in today's narrow formalism but in the 1920's, when Dewey's philosophy was strongly influencing Soviet practice. The lessons of these accomplishments relate visibly, not to questions of general education, but to specific problems of military-scientific planning and coordination. They must also be viewed in relation to the distortion of research effort which they have imposed on Soviet science and technology, particularly in the constriction of resources in fields such as medicine and agriculture.

The problem of scientific personnel strength is one of great complexity. It must suffice here to say that much excessive alarm in this regard has been aroused by conceptually invalid comparisons and by failures to take into account specific demographic fluctuations, including war-caused peaks of delayed education. In general, while the Soviet Union currently has a greater output of first-degree graduates in a number of professional fields, both present total strengths and the outlook a decade ahead is definitely favorable to the United States. The problem in fact will be one of making available facilities and jobs rather than that of a potential scarcity of human resources.

Oxygen Shortage Kills Crabs

➤ A SEVERE oxygen shortage in the waters of the Virginia and Maryland crab fisheries is taking a heavy death toll of the delectable crustacaen. Unusually heavy rains that bring organic material into the bays and large rivers, high temperatures, and calm weather that prevents water mixing by winds are believed to be responsible for the oxygen shortage, Dr. J. L. McHugh, director of the Virginia Fisheries Laboratory reported. Some water deeper than 20 feet contains no oxygen at all, Laboratory biologists report.

American Institute of Chemical Engineers

Another in CHEMISTRY's Series on Professional Organizations That Tell Their Place in American Chemistry

➤ The American Institute of Chemical Engineers (A.I.Ch.E.), founded in Philadelphia in 1908, is the sole professional association of chemical engineers in the United States. It was founded to advance the theory and practice of chemical engineering in theory and practice and to maintain a high professional standard among its members. When A.I.Ch.E. was formed to recognize what was then a new profession, there were only about 500 people in the United States who could be termed chemical engineers. Today the number is between 45,000 and 50,000.

A.I.Ch.E. fosters the professional standing of individuals who practice chemical engineering and promotes the development of the profession for the benefit of mankind. It has 59 local Sections in the important industrial areas of this country, in addition to more than 100 student chapters in colleges and universities. Today, the membership of A.I.Ch.E., excluding students, is 19,900.

The Institute operates largely through voluntary committees in all significant fields of the profession, such as nuclear engineering, chemical and metallurgical processing, equipment testing, air pollution control, instrumentation, automation, etc. The Institute also provides information on new developments in the chemical industry, cooperates with and is represented in many professional scientific societies in the United States and abroad, such as the Engineers Joint Council, Engineers' Council for Professional Development, National Research Council, Conference of Representatives from the Engineering Societies of Western Europe and the United States of America, Chemical Institute of Canada, American Association for the Advancement of Science, etc. In other words, A.I.Ch.E. is one of the great brotherhood of national and international scientists and engineers.

The Institute was the first engineering society to evaluate and accredit engineering curricula in various colleges and universities. It also formulates and encourages standards of practice in chemical engineering. A.I.Ch.E. sponsors three national and one annual meeting each year, at which developments and discoveries in the profession are presented and discussed. At the annual meeting several awards are made for professional accomplishment.

The Institute founded the Nuclear Engineering Congress and Atomic Exposition in 1955, the first international activity in nuclear engineering by any professional society. The Congress and Exposition are now annual events.

A.I.Ch.E. membership grades are student, affiliate, associate and member. They are designed to encourage early participation of the student and young engineer in the activities of his

professional society, and to encourage and stimulate the mature engineer in advancing in his profession. The national headquarters of the Institute are located at 25 West 45th St., New York 36, N. Y.

The Institute publishes a monthly magazine, *Chemical Engineering Progress,* devoted to the industrial applications of new developments in the chemical engineering field; a quarterly magazine, *The A.I.Ch.E. Journal,* which carries the more fundamental (mathematical) aspects of chemical engineering. Standards on equipment, materials, and testing procedures, as they are developed by special Institute committees, and numerous pamphlets are distributed from time to time fostering specific areas of the field.

√ *Chemistry Quiz* √

Directions: Mark within the parentheses corresponding to the answer you think is *most nearly correct.* Answers are on page 38.

1. For the most part, the mass of our sun consists of
   ( ) 1. hydrogen
   ( ) 2. inert gases
   ( ) 3. nearly equal parts of hydrogen and helium
   ( ) 4. the same elements found on earth

2. Which of the following is the *most* accurate definition of *antibiotics*?
   ( ) 1. Substances, derived from living microorganisms, which have an antimicrobial effect.
   ( ) 2. Substances produced by molds and bacteria which have an antagonistic or lethal effect on other living organisms.
   ( ) 3. Substances used for the destruction of microbes which cause disease in living organisms.
   ( ) 4. Substances which display a definite inhibitory or lethal effect on microbes.

3. Mercury is used as a solvent in refining
   ( ) 1. aluminum
   ( ) 2. calcium
   ( ) 3. potassium
   ( ) 4. silver

4. The population of the world is increasing at the rate of about 60,000 per day. Which of the following problems does such a fact probably make most urgent?
   ( ) 1. clothing
   ( ) 2. food
   ( ) 3. sanitation
   ( ) 4. shelter

5. Which phrase is a synonym for *lunar caustic*?
   ( ) 1. potassium hydroxide
   ( ) 2. silver hydroxide
   ( ) 3. silver nitrate
   ( ) 4. sodium nitrate

From Ether to Cyclopropane

Anesthesia and Chemistry

by A. H. Neeley

Manager of Chemical Product Development, Ohio Chemical & Surgical Equipment Co., Murray Hill, New Jersey

➤ It would be difficult to imagine the successful practice of modern surgery without the use of some agent capable of rendering one insensible to pain. Yet for centuries, anesthetics — at least as we are familiar with these agents today — were not available to medical practitioners for the alleviation of pain during surgery.

Anesthesia, and, in particular, inhalation anesthetics, are a development of modern man. More importantly, they are a contribution of modern chemistry to the betterment of all mankind.

Although the value of inhaling certain gases to obtund pain had been indicated prior to 1840, no effective means of inducing a state of anesthesia by inhalation methods was in common practice. It remained for William T. C. Morton in 1846 to demonstrate publicly for the first time the beneficial effects of administering diethyl ether as an inhalation anesthetic during a surgical procedure. Although Dr. Morton had been preceded by others in the use of inhalation agents to allay pain, his was the first successful public demonstration and acceptance by the medical profession dates from this event.

During the decade from 1840 to 1850, tremendous advances were made in the development and use of various inhalation anesthetic agents. The first agent to be introduced was nitrous oxide which was actually discovered in 1772 by Joseph Priestley but was not utilized as an anesthetic until 1844. Shortly after Dr. Morton in 1846 demonstrated the use of ether during surgery in America, James Y. Simpson introduced the use of chloroform to relieve pain in childbirth in England. These three agents, however, remained the only inhalation anesthetics to be used in common practice until after World War I.

Today, there are many such anesthetic agents in common use, and, thanks in large part to chemical research, still newer and, it is to be hoped, better inhalation anesthetics are on the horizon to aid anesthesiologists in the near future. In addition to the three anesthetics mentioned, agents in common use today include ethylene, introduced in 1923; cyclopropane, used clinically for the first time at the University of Wisconsin in 1933; divinyl ether also introduced at the University of Wisconsin during the Nineteen Thirties; trichloroethylene, introduced in 1935; and ethyl vinyl ether, first used clinically in 1947. Other anesthetics have been developed in the laboratory and have been reported in the professional literature of recent years, but as yet have not received widespread acceptance.

As utilization of inhalation anesthetics has grown in recent years, so,

too, has the number of those who have specialized in their administration been constantly increasing. The Long Island Society of Anesthetists, forerunner of the present American Society of Anesthesiologists, was organized in 1905 with only nine members, all of whom were physician-anesthetists. Today, the American Society of Anesthesiologists has grown to a membership of 5,571 members, all specialists in the art and profession of administering anesthesia as well as in the management of patients before, during and following surgical procedures. As of July 30, 1957, there were 1,649 Fellows of the American College of Anesthesiologists and 1,697 Diplomates of the American Board of Anesthesiology.

Growth of Research

Simultaneous with the growth in recent years of the profession of anesthesiology has been the growth of chemical research and development in the field of inhalation anesthesia. Reference to the literature will show the continued effort which has been expended in the development of new agents and the demonstration of their safety. The development of improved methods for the production and purification of the commonly used ones has kept pace with these advances.

A typical example of the way in which chemistry has been contributing to the improvement in manufacture of anesthetic agents can be seen in the case of nitrous oxide. Until recently, nitrous oxide was produced by the decomposition of ammonium nitrate by a batch process. In this process, the solid salt was melted and the molten ammonium nitrate was charged into reactors where, upon application of controlled amounts of heat, it decomposed to form nitrous oxide, water and traces of other by-products. This method had certain disadvantages, among which was the difficulty in controlling the addition of heat which directly affected the rate of decomposition. Another disadvantage was the fact that ammonium nitrate was used in the process as a dry salt, necessitating careful and laborious handling.

To overcome manufacturing and handling difficulties, the Ohio Chemical & Surgical Equipment Co., a division of Air Reduction Company, Inc., developed a continuous process in which a concentrated water solution of ammonium nitrate can be fed as makeup to the reactor at a rate equal to its rate of decomposition. As a result, ammonium nitrate is now used as a concentrated water solution which can be transported in tank cars, transferred to storage tanks and finally to the reactor by means of pumps, thus eliminating all manual handling of the raw products. Since the reactor is run at a constant level, super heating does not occur and the production of by-products is kept to a much lower level than in the old batch process.

Improved Manufacture

Manufacture of cyclopropane is another example of where chemistry is providing improved methods in the manufacturing process. Formerly, cyclopropane was manufactured by the treatment of 1,3-dibromopropane in alcohol media with zinc. Dibromopropane was prepared from trimethylene glycol, which is formed, along with glycerol, during the saponification of fats for the soap industry. The

supply of trimethylene glycol was limited and varied in available quantities.

In order to eliminate the uncertainties of the supply of trimethylene glycol and the expensive process required to convert it to 1,3-dibromopropane, a new method of manufacture was developed.

Cyclopropane obtained by this method is ultimately derived from petroleum in four steps: (1) crude petroleum in the cracking process is converted to propylene and other hydro-carbons; (2) propylene is recovered from the cracking process and treated with chlorine in the vapor phase to form allyl chloride; (3) allyl chloride is treated with hydrogen bromide in the presence of a catalyst to form 1-chloro-3-bromopropane; (4) 1-chloro-3-bromopropane is treated with zinc in water media to form cyclopropane.

This method is a great improvement over the previous one and utilizes less expensive raw materials which are obtainable in adequate supply to meet increasing demands.

These are but two of the many ways in which chemistry is now at work in an effort to improve and ultimately perfect anesthetic agents and their manufacturing methods. It is a contribution not alone to science, but, in addition, to all mankind.

Statistics Do Not Replace Engineering

➤ FULL USE should be made of modern statistical methods to complement, not replace, engineering and chemical principles to obtain effective prediction from chemical experimentation.

This advice was given by S. L. Anderson, of E. I. Du Pont de Nemours & Co., Wilmington, Del.

"The aim of most chemical investigations," he said, "is to predict the behavior of a process or the properties of a product. An effective experiment then is one which results in the broadest possible reliable predictions from a specified amount of experimental effort. Therefore, statistical methods play a role in the strategy of experimentation to the extent that they aid in this effectiveness."

Mr. Anderson said that statisticians "must not substitute as a basis for quantitative measurement a blind adherence to elaborate statistical schemes, such as latin squares, composite rotatable designs and the like. These tools are extremely useful, but they are not the basis or cornerstone of our conceptual thinking about the system under study.

"This basis must be supplied by the chemist or engineer conducting the investigation. However, to capitalize on the knowledge of the system, the engineer must seek the new methods which specify efficient designs for and pertinent analysis of data at each step of his experimental program. He must use the science of experimental strategy, statistics, which is a more powerful catalyst than experience and intuition in obtaining a high yield of pertinent information from engineering principles and experimental budgets."

➤ T. C. RUNION, *right, general manager of Nuclear Materials Operation, W. R. Grace & Co., Davison Chemical Division, in the plant at Erwin, Tenn., examining a shipment of "yellow cake" uranium concentrate prior to its charge into the grinding circuit.*

Uranium Purchased from Private Source

➤ PURCHASES from private sources of uranium concentrates for conversion to nuclear reactor feed materials have been made in quantity for the first time by W. R. Grace & Co., Davison Chemical Division.

The purchases were made from the Uranium Reduction Company, Moab, Utah mill, with the permission of the Atomic Energy Commission, previously the only authorized source of uranium materials for reactors. Other private sources are now available.

Considered a major step in the development of a nuclear power industry on a completely private basis, the AEC permission has enabled the Davison nuclear materials plant, Er-

win, Tenn., to take uranium concentrates as "yellow cake" — approximately 70 per cent tri-uranium octo-oxide (U_3O_8) — directly from the miners and by a series of chemical processes convert raw materials to natural uranium oxide or metal for power reactor feed uses. Permission to initiate the purchases was obtained in an exchange of correspondence with the AEC by T. C. Runion, general manager of nuclear reactor materials for Davison.

Where uranium materials enriched with fissionable U_{235} are needed, the AEC continues to be the sole source of supply. Davison obtains for processing such materials, usually in the form of uranium hexafluoride at various enrichments, on license from the AEC, which only leases and does not sell the enriched materials to industry.

The Davison plant at Erwin, a unique, completely integrated private industry facility for production of nuclear reactor feed materials, processes thorium for such purposes as well as uranium.

In outline, the process now on a strictly private basis is as follows:

The yellow cake, produced in acid leach plants, and shipped here, is digested in nitric acid and purified by solvent extraction, resulting in uranyl nitrate solution, which is broken down by thermal decomposition into uranium trioxide. This in turn is treated with hydrogen at high temperatures to derive uranium dioxide.

Uranium dioxide is treated with anhydrous hydrofluoric acid to make uranium tetrafluoride, which is turned into "derby metal" by treatment with magnesium.

Derby metal is a very pure form of uranium metal. It is melted and cast into ingots or special shapes. Davison ships ingots to Bridgeport Brass Co. at Adrian, Mich., for extrusion into rods. The rods in turn can be machined into finished full elements.

Stellar Temperatures in the Laboratory

➤ Temperatures many times as high as the sun's surface have been reached momentarily in the laboratory.

Dr. Alan C. Kolb, U. S. Naval Research Laboratory, told how the luminous temperatures were generated in a shock tube in *Physical Review*, journal of the American Physical Society.

A changing magnetic field is used to keep the deuterium gas away from the walls of the shock tube. Dr. Kolb produces the shock wave by a very high voltage discharge between two electrodes at one end of the T-shaped tube.

Shock waves, because of the stellar-like temperatures they generate, have been suggested as a method of triggering hydrogen bombs without exploding an atomic bomb — a possible avenue to the so-called "clean" bomb.

Since heat is the energy of atoms in motion, the violently agitated gas particles behind the shock front reach incredibly high temperatures for an instant. Dr. Kolb warns, however, that no "direct" measurement of the deuterium's temperature has yet been made. Based on the Rankine-Hugoniot scale, he has found temperatures as high as 700,000 degrees Kelvin.

New Nitrile Silicone

➤ A NEW SYNTHETIC rubber that is unharmed by oils and aviation fuels, and retains its properties at high jet aircraft temperatures, as well as at very low temperatures has been revealed.

The nitrile silicone rubber maintains its strength at temperatures ranging from 100 degrees below zero Fahrenheit to 500 degrees above.

Most important to America's national defense program, however, is the rubber's resistance to oil, kerosene and aviation fuels, making possible new designs of gaskets, fuel lines and other components of modern aircraft.

The latest entry in the rapidly growing field of specialty silicones was demonstrated by the General Electric Research Laboratory of Schenectady, N. Y.

Although many of the individual properties of the new rubber are found in other recently developed synthetics, the GE product is the first to claim marked oil resistance at such a wide temperature range of operation.

The new rubber is essentially a silicone, a compound which can be visualized as a normal organic compound in which silicone replaces carbon.

➤ THESE *two O-rings were the same size when immersed in this jar of boiling (350 degrees F.) JP-D jet engine fuel. One of them, made of General Electric's new nitrile silicone rubber, has maintained its size and shape. The other, made of ordinary silicone rubber, has swollen to nearly twice its original size.*

System Warns Against Smog

➤ FARMERS in Riverside, Calif., have an advance warning system set up so they can defend their crops against smog attack. The system alerts farmers by telephone and gives them time to spray celery, lettuce and spinach with vitamin C which can prevent smog damage. Dr. Hugh T. Freebairn, University of California biochemist who discovered the vitamin can protect against smog, says the warning-spraying system "shows promise." There is close cooperation between air pollution control districts in the counties involved and A. H. Holland, a county farm adviser. The farm adviser telephones smog warnings to farmers.

Teachers Set Patterns For Students

➤ STUDENTS who seem to be potential scientists should be given an opportunity to work with scientists, Dr. Margaret Mead, world famous author and anthropologist, urged recently.

The entire role of science teachers needs to be reconsidered, Dr. Mead declared.

Male teacheres who prefer to teach other subjects, but have been induced to teach science, must be rescued, Dr. Mead said. There should be a reinforcing of those women good in mathematics and physics, who have been diverted from science teaching because they are females.

The science teacher today is expected to be a model of two kinds of people simultaneously — a scientist concerned with research and a teacher concerned with teaching, Dr. Mead said. But boys, who are believed to be the appropriate sex from which scientists and engineers will come, tend to identify themselves with male teachers. This tends to overstress the identification factor.

The appropriate role of the science teacher is to interest a student, not in being a scientist by identification, but in the process of scientific investigation, Dr. Mead declared.

"The most frequent negative comment from students, 'I am not interested in science' is found to mean 'this is something which I can do nothing with'. Boredom, apathy and active rejection follow an inability to do, use, and make sense of something in a culture where learning is by doing."

Outlining the plan being developed by Watson Davis of Science Service for a science youth information service to put the isolated, gifted child in touch with working scientists in his area, through the mechanism of committees of regional science fairs, Dr. Mead felt that this plan "combines all the advantages of our large population and mass communications with the need for face-to-face apprenticeship relationships between present and future scientists.

Students react strongly against a disliked science teacher. They take a good teacher for granted, she said.

Increasing the recognition and respect accorded the science teacher is empty exhortation unless it is accompanied by a widening of his role in the eyes of his students, the students' parents, and the scientific leaders in the community.

√ Answers to CHEMISTRY QUIZ on page 31.
1, 3; 2, 1; 3, 4; 4, 2; 5, 3 √

National Science Youth Month

➤ OCTOBER IS National Science Youth Month. National organizations are cooperating in a month-long action program to inspire and inform youth in our schools about career opportunities and qualifications in science and technology.

Millions of students form the nucleus of this science activities drive. Organization of science clubs and science fairs in all parts of the country is being stressed.

A calendar of events has been prepared and information assembled for those in local and regional organizations who wish to cooperate.

A science youth organizations working group appointed by the President's Committee on Scientists and Engineers is spearheading National Science Youth Month. This is the third year that October has been National Science Youth Month.

Greatly increased interest in discovering and stimulating youthful ability in science and technology is reflected in new or expanded science youth programs set up by national organizations. Nine additional agencies are cooperating in National Science Youth Month in 1958. These include the American Dental Association, the American Veterinary Medical Association, the Department of Defense, the National Academy of Sciences — National Research Council, the National Committee for Careers in Medical Technology, the Scientific Apparatus Makers Association, the U. S. Air Force and Air Force Association, the U. S. Army and the U. S. Navy.

National organizations and activities continuing their support are: American Association for the Advancement of Science, American Chemical Society, American Medical Association, Chamber of Commerce of the United States, Thomas Alva Edison Foundation, Junior Engineering Technical Society, Manufacturing Chemists Association, National Association of Manufacturers, National Merit Scholarships, National Science Fair, National Science Foundation, National Science Teachers Association, Oak Ridge Institute of Nuclear Studies, President's Committee on Scientists and Engineers, Science Achievement Awards Program, Science Clubs of America, Science Service and Science Talent Search.

Hulls Protected by Platinum

➤ A TINY PLATINUM electrode has been developed to control corrosion of steel-hulled pleasure boats. Devised by Charles Engelhard, Inc., the tiny electrode contains about the same amount of platinum as three wedding rings. It works by applying a controlled electric current to the hull which neutralizes the current generated by corrosive action. The system was demonstrated at the annual Small Boat Builders Corrosion Conference at Harbor Island, N. C.

More Support Urged for College Research

➤ INCREASED Government support of basic research at colleges and universities has been urged by the National Science Foundation.

In a report titled "Government-University Relationships in Federally Sponsored Scientific Research and Development," the NSF also called for continuity of financial support in the interests of effective conduct of basic research.

The report, submitted to President Eisenhower, contained many recommendations aimed at serving the Government's research needs and at the same time safeguarding the strength and independence of institutions of higher learning.

Among the report's recommendations were:

1. Problems of Government-university relationships in the Federal support of research should be completely dissociated from the budgetary needs of the institutions and from the general issue of Federal aid to higher education.

2. Continuity of support is unanimously agreed to be essential for the effective conduct of basic research.

3. Federal agencies should consider other alternatives before establishing within universities large-scale applied and development projects, particularly those concerned with development and testing.

4. No Federal agency should agree to reimburse institutions for salaries of faculty members engaged in Government-sponsored research at a rate in excess of the university rate.

5. Government-sponsored classified research on college campuses should be reduced to a minimum consistent with national security.

6. Federal agencies should have legal authority to give institutions title to research equipment procured by them through grants or contract funds unless a clear and definite need exists for Government control or use of the equipment.

Copies of the report may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 40 cents.

Research Becomes an "Industry"

➤ SCIENTIFIC RESEARCH is not only one of the most valuable and respected professions, but it also has become one of the most rapidly changing and growing industries in America.

Fifty years ago there were so faw industrial laboratories that manufacturers of scientific equipment sold apparatus and supplies chiefly to schools. Since 1920, acording to the National Research Council, the number of laboratories in the country has increased from 297 to 4,834.

Edison found that electrons will boil off from any substance brought to high enough temperature and these electrons can carry a current through a vacuum.

A-Power To Be Competitive by 1965

➤ By 1965 nuclear power will be economically competitive with conventional steam plant power, a Columbia University engineer has predicted.

John E. Ullmann said the cost of nuclear power would begin to compete within two years and that it would be completely competitive within ten years.

His forecast, more optimistic than most made to date, assumes that costs of conventional power in the future will rise.

Mr. Ullmann also assumes that nuclear power costs in the future will be reduced at the same rate as have costs for steam power plants decreased since 1910.

These two assumptions are then blended to produce a prediction of "break-even" points, beyond which nuclear power may be expected to have an increasing economic advantage.

Nuclear power costs could be reduced in the future, Mr. Ullmann suggests, by using higher steam working pressures, by cutting down on personnel, by developing suitable substitute materials for the present expensive ones, and by safely lowering construction standards as experience is gained.

Mr. Ullmann considered only steam-cycle nuclear plants. He did not attempt to estimate costs of direct generation fission or fusion plants but concluded that if such plants are feasible, they would "hasten the demise of the coal-fired steam plant even more."

By 1968, Mr. Ullmann predicted, even the highest cost of nuclear power will be about the same as the lowest costs of conventional steam power. That date will come sooner if nuclear power plants are put into operation at a rate faster than now expected.

However, if the construction rate for nuclear plants is lower, the 1965 date would still hold, Mr. Ullmann contends. He explains that large-scale reactors now being built in other countries, particularly in Europe and Russia, will result in reduced costs.

Mr. Ullmann estimates that nuclear power will cost about 12 mills per kilowatt hour in 1960, from six to eight mills by 1965. In contrast, conventional plants, depending upon their capacity, will yield power costing from 5.75 to 14.35 mills per kilowatt hour.

Mine Safety Device Aids Children

➤ Pennsylvania's 8,000 school buses are being examined during August for any possible traces of highly-poisonous carbon monoxide gas. A device often used to inspect coal mines for pockets of the deadly gas is being used to determine whether any of the school bus engines or exhaust systems are faulty and are producing carbon monoxide. Officials of Mine Safety Appliances Co., Pittsburgh, manufacturers of the detector, trained state policemen in its use. The inspection is a routine part of a new safety program.

A-Powered Plane Being Developed

➤ A NUCLEAR propulsion system and radiation shields that could keep a military plane safely in the air for weeks or months without refueling are being developed in a much shorter time than it would take to bring about such a radical innovation in other fields.

The rapid development of a nuclear aircraft power plant is being made possible by today's routine use of "critical assemblies" to study radiation characteristics, and by large-scale computers, Dr. D. S. Selengut, Aircraft Nuclear Propulsion Department, General Electric Company, Evendale, Ohio, reported recently.

He said scientists today are routinely setting up critical assemblies and making radiation measurements that "10 years ago would have been the subject for a learned article in a leading scientific publication."

Computers are cutting days and weeks of mathematical computation down to hours, the engineer said. "To arrive at the design region of a typical aircraft reactor you may have to analyze on the order of a hundred configurations or more," he said. Each of these configurations would have required a week of hand computation by the "simple methods in use a few years ago."

Although the job of developing a shield strong enough to protect the airplane's crew from reactor radiation and at the same time be light enough for use in aircraft has been beset with problems, considerable progress has been made in the past few years, reported Dr. F. A. Aschenbrenner, in charge of the shield development program at General Electric's ANPD plant.

He cautioned that much work remains to be done, but "we have learned enough so that the approach from here is straightforward."

Rockets To Travel 2,000,000 MPH

➤ SPACE SHIPS traveling at speeds of more than 2,000,000 miles an hour have been predicted by Dr. Winston H. Bostick of Stevens Institute of Technology, Hoboken, N. J.

Both Western and Russian scientists have already accelerated samples of ionized gas to speeds of more than 300,000 miles an hour in their experiments aimed at taming the hydrogen bomb for peaceful power.

If the mechanism that produces these speeds for ionized gases is thought of as a propulsion motor for space ships, Dr. Bostick said, then speeds of more than 2,000,000 miles an hour are possible.

The nuclear fusion process extracts energy directly in electrical form. In present-day reactors, energy is produced first as heat, then converted into electricity by heat exchangers and generators. In the fusion reactor of the future, electricity could be produced directly from the motion of free electric charges.

Treat Radiation Sickness with Transfusions

▶ THE SEVERE illness following X-rays and radioactive radiation in the treatment of cancer can be treated successfully by transfusions of blood and its leucocyte and thrombocyte components, a Russian group headed by A. A. Bagdasarov told the Second United Nations International Conference on Peaceful Uses of Atomic Energy in Geneva.

Studying 250 patients with various cancerous conditions requiring radiation, it was found that 80% were aided by the transfusions to the point that it was possible to continue the radiation treatments. The leucocyte preparation used at the Central Institute of Hematology and Blood Transfusion was made from non-citrated blood preserved with the aid of ion exchange resins. This gave a longer life for the lucocytes.

The female is tougher than the male, at least in mice, when it comes to resisting the effects of large doses of atomic gamma radiation, Drs. W. L. Russell and Liane Brauch Russell of the Oak Ridge National Laboratory, Tenn., reported. The offspring of irradiated female mice have fewer changes than those caused in the progeny when the fathers alone were subjected to radiation. This female advantage may apply to human mothers and gives a hope that the effects of atomic war damage may be less than anticipated.

Even a single heavy dose of X-radiation to female rats 40 days old is followed by a large amount of breast cancer within 11 months of the exposure, a group from Brookhaven National Laboratory's medical department led by Dr. V. P. Bond, reported. Removal of the ovaries before radiation reduced the cancer incidence, but shielding of head and ovaries did not reduce the effects of the radiation given over the whole body. This rat experiment may also have human applications.

Contrary to previous ideas, two U.S.S.R. scientists, M. N. Livanoy and D. A. Biryukov reported that there are profound effects upon the brain and central nervous system from ionizing radiations.

Space Missile Re-Entry Simulator Built

▶ A SPACE AGE simulator that duplicates in the laboratory the tremendous heats and stresses any vehicle re-entering the earth's atmosphere at great speeds would have to withstand has been built by the National Advisory Committee for Aeronautics at its Ames Laboratory, Moffett Field, Calif.

Using the new device, a model about a third of an inch in diameter, weighing five-thousandths of a pound, can simulate the re-entry flight of a full-scale 4,000-mile range missile of three-foot diameter, weighing 5,000 pounds. The atmosphere entry simulator was designed by Dr. Alfred J. Eggers Jr. of Ames Aeronautical Laboratory.

Western U.S. Yields Major Chemicals

➤ PARTS OF western United States, only recently developed commercially, contain major—in many cases "huge" —deposits of minerals and chemicals valuable to our national economy, a meeting of the American Institute of Chemical Engineers has been told.

The problem involved in exploiting our strategic western resources is the scarcity and high cost of transportation, V. E. Larson of Food Machinery and Chemical Corporation, Pocatello, Idaho, said.

The western region, which Mr. Larson described as those states generally bordering the Rocky Mountains, holds vast deposits of oil, oil shale, natural gas and coal. There is, he said, a great abundance of limestone, phosphate-bearing rock, sulfur, salt, sand and soda ash-bearing trona.

In addition, Mr. Larson reported there are "adequate amounts" of copper, lead, zinc, iron and other metals.

The region's basic problems, he said, are the lack of transportation facilities and the long distance to market.

"Many good properties are undeveloped because it is not economically feasible to build a road or railroad into the property," he told the chemical engineers. In addition, he said, "frequently freight costs to market are higher than the value of the ore" at the mine.

He predicted that the situation will not change very much in the near future. However, he pointed out, new properties probably will come under development as local markets are created or expand.

Heat-To-Electricity Ceramics

➤ A POTENTIALLY useful means of developing electrical energy directly from heat by the use of materials related to pottery and brick has been revealed.

Tiny electrical power generators that do not involve moving parts nor require bulky storage batteries may be developed to operate guided missile and artificial satellite instruments, thanks to pioneering research on ceramic materials.

Dr. Clarence Zener, director of Westinghouse Research Laboratories, Pittsburgh, disclosed the new flame-to-electricity conversion materials before a conference on thermoelectricity sponsored by the U. S. Naval Research Laboratory.

The materials, when heated by a flame or other high temperature source, set up an electrical current that can be harnessed for useful work.

Dr. Zener explained that the ceramic-like materials overcome disadvantages of earlier heat-to-electricity conversion techniques. They are common materials, compounds of metals such as nickel and manganese, and would put no burden on our stockpile of critical materials. They do not require ultra-high-purity refining, high-vacuum operation or complex electronic apparatus.

New Relationship for Life Chemicals

▸ NEW FACTS which are shaking the rigid concept of the chemical relationship between chromosomes and genes in cellular structure have been described.

The theory has long been accepted that the important substances in heredity and the gene-chromosome relationship are giant molecules of deoxyribonucleic acid, called DNA for short.

The hereditary characteristics of a living organism are believed to depend upon these molecules. The structure of each molecule is believed to correspond to a code, which in turn imprints a message in the structure of other substances, Dr. George Rudkin of the Institute for Cancer Research, Philadelphia, has said.

Work of the cell is supervised by directions given from the DNA code, according to the present theory. In animal and plant cells the DNA is mostly carried in fibers called chromosomes on which the genes are strung out, resembling a strand of pearls.

It has been believed up until now that the amount of DNA per chromosome was roughly constant. This in turn, was interpreted as meaning that the different kinds of genes, hereditary factors, were the same in all cells during their life cycles. Therefore, he said, it was believed that the only function of DNA was to provide directions.

But Drs. Rudkin and Jack Schultz, also of the Institute of Cancer Research, investigated a species of larva of a family of Brazilian flies. They found that when particular parts of the chromosomes of these flies became enlarged the amounts of DNA increased.

This means, Dr. Rudkin explained, that this increased amount of DNA dispels the theory that DNA gives directions only. Now it is believed that it can be used in the growth process itself as well.

This work has been the result of cancer research, based on the theory that cancer cells differ from other cells in their heredity.

Lengthy Isotope List Appears

▸ IT NOW TAKES 319 pages to list all the known isotopes, which are so important in industry, medicine and basic research today. In 1940, when the isotope list was first published by the American Physical Society in *Reviews of Modern Physics*, only 17 pages were needed. Isotopes are forms of elements having the same atomic number but different atomic weights. For example, U-235, U-238 and U-239 are all isotopes of uranium.

Milk contains nearly a dozen minerals, high quality proteins, milk sugar and other vitally important milk solids.

A widely accepted theory explains that appetite signals are turned on and off by fluctuating levels of glucose in the blood.

Book Condensations

EXPLORING CHEMISTRY — Roy A. Gallant — *Garden City Bks,* 120 p., illus by Lee J. Ames, $2.95. Shows the young reader some of the dramatic developments in chemistry since early times.

SEMIMICRO EXPERIMENTAL ORGANIC CHEMISTRY: A Laboratory Manual — Nicholas D. Cheronis — *de Graff,* 400 p., illus., $5.50. Completely rewritten text based on 1943 work SEMIMICRO AND MACRO ORGANIC CHEMISTRY by the same author.

OIL: From Prospect to Pipeline — Robert R. Wheeler and Maurine Whited — *Gulf Pub. Co.,* 115 p., illus., $2.95. Describes technical operations in layman's language. Includes oil dictionary and abbreviations.

THE WORLD OF CARBON — Isaac Asimov — *Abelard-Schuman,* 178 p., diagrams by author, $2.75. Makes the carbon part of organic chemistry a story of absorbing interest to the general reader.

THE MAN-MADE FIBRES INDUSTRY — R. Robson — *St. Martins,* 135 p., $5. Gives an account of the development of this rapidly changing industry.

VINYL RESINS — W. Mayo Smith — *Reinhold,* 282 p., illus., $5.75. Describes types and applications of this most versatile and largest selling family of plastics.

THE ACADEMY OF SCIENCES OF THE USSR REPORTS OF THE FOURTH SOVIET CONFERENCE ON ELECTROCHEMISTRY — A. N. Frumkin and others in English translation — *Consultants Bureau,* 89 p., paper, $12. Discusses general questions on electrochemical kinetics and reaction mechanism of electrochemical reduction.

THE HANDBOOK OF ROCKETS AND GUIDED MISSILES — Norman J. Bowman — *Perastidion Press,* 328 p., illus., $6.50. Compilation of data on rockets and missiles, both modern and historical, arranged alphabetically.

MINERALS YEARBOOK 1956, Vol. II: Fuels — U. S. Bureau of Mines — *Govt. Printing Office,* 452 p., $2.50. Minerals — fuel review chapter summarizes developments in the fuel industries, followed by commodity reviews.

GAS CHROMATOGRAPHY: A Symposium Held Under the Auspices of the Analysis Instrumentation Division of the Instrument Society of America, August, 1957 — Vincent J. Coates, Henry J. Noebels and Irving S. Fagerson, Eds. — *Academic,* 323 p., illus., $10. Symposium aimed at maximum interchange of information and free discussion of advances in gas chromatography.

JET PROPULSION — Walter J. Hesse — *Pitman,* 567 p., illus., $9.75. One- or two-semester course at the junior and senior engineering levels, or first-year graduate level.

THE PROPERTIES OF GASES AND LIQUIDS: Their Estimation and Correlation — Robert C. Reid and Thomas K. Sherwood — *McGraw-Hill,* 386 p., $10. Critical review of the various practical estimation procedures.

PRINCIPLES OF CHEMISTRY — Donald C. Gregg — *Allyn and Bacon,* 600 p., illus., $6.50. An elementary text attempting to simplify by generalization as much as is reasonable.

RADIOISOTOPES: A New Tool for Industry — Sidney Jefferson, foreword by Henry Seligman — *Philosophical Lib.,* 110 p., illus., $4.75. To give businessmen insight into the varied ways in which industry can benefit from the use of radioisotopes.

SYMPOSIUM ON RADIOISOTOPES — Charles E. Crompton and others — *American Society for Testing Materials,* 94 p., illus., $2.75. Use of radioisotopes in industry is saving hundreds of millions of dollars each year.

NUCLEAR RADIATION DETECTION — William J. Price — *McGraw-Hill,* 392 p., illus., $9. Gathering together the basic information on all the important nuclear radiation detectors in use today.

TOPICS IN MICROBIAL CHEMISTRY: Antimycin, Coenzyme A, Kinetin and Kinins — F. M. Strong — *Wiley.* Presenting a "capsule view" of several individual research projects.

ALIPHATIC FLUORINE COMPOUNDS— A .M. Lovelace, Douglas A. Rausch and William Postelnek — *Reinhold,* 370 p., $12.50. A complete and concise collection of these compounds from Moissan's time to the present. From the point of view of preparative organic chemistry.

CHEMICAL SPECIALTIES MANUFACTURERS ASSOCIATION, PROCEEDINGS OF THE FORTY-THIRD MID-YEAR MEETING — Harry E. Peterson and others — *Chemical Specialties Manufacturers Association,* 193 p., illus., paper, $7.50. Complete transcripts of technical papers.

THE SPECTRUM OF ATOMIC HYDROGEN — G. W. Series — *Oxford Univ. Press,* 88 p., illus., paper, $2. Since hydrogen is the simplest kind of atom, the interpretation of its spectrum has been of the greatest interest to theorists.

REPORT OF THE HIGH-STRENGTH HIGH-TEMPERATURE MATERIALS FOR STANDARD PARTS SYMPOSIUM—Charles Sheckells, Chairman — *Nat. Aircraft Standards Assn. Committee,* 393 p., illus., paper, $5. Discusses materials needed for missiles, satellites and rockets.

METALS AND ENZYME ACTIVITY — Biochemical Society Symposium No. 15 — E. M. Crook, Ed. — *Cambridge Univ. Press,* 102 p., illus., $3.75. Of interest to research workers including inorganic and organic chemists, biochemists and those in the medical sciences.

BIBLIOGRAPHY ON THE EFFECTS OF IONIZING RADIATIONS ON PLANTS, 1896-1955 — Arnold H. Sparrow, John P. Binnington and Virginia Pond — *Brookhaven Nat. Lab. (Office of Technical Services),* 222 p., paper, $2.25. List of conferences and symposia, list of references, and subject index.

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